Federal Natural Resources Development: Basic Issues in Benefit and Cost Measurement

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For well over one hundred and fifty years now, the federal government has undertaken expenditures to develop the nation's natural resources. Federal spending in these areas currently totals over $3.5 billion per year and accounts for some of the nation's largest physical structures.

Water resource installations have productive potentials similar to those of industrial investments generally. These projects absorb inputs and produce outputs. Among the primary "products" which these installations produce are irrigation water, the reduction of flood hazards, the provision of transportation services, hydroelectric energy, and the provision of municipal water supply. The inputs which they use are similar to those used in common industrial enterprises: skilled and unskilled labor, steel, cement, bulldozers, and complex electrical generating equipment.

The fact that these projects absorb valuable inputs and produce valuable outputs provides the opportunity of measuring the benefits from such government undertakings as well as the costs which they entail. The comparison of the resulting benefits and costs is necessary if prudent public expenditure policy is to prevail.

Interest in procedures to determine the contributions of natural resource projects to the nation's economic welfare is not a new one. Indeed, explicit efforts to account for the expected benefits and costs of projects have been made for over 30 years. The basic criterion for determining the worth of proposed projects was formally outlined in the Flood Control Act of 1936, which stated that the federal government was prepared to undertake such investments "if the benefits to whomsoever they accrue exceed the costs." This criterion still guides evaluation efforts in the natural resources development area.

Both the Senate Committee on Interior and Insular Affairs and the Senate Public Works Committee have stated that: "The economic analyses of projects should reflect the broadest scope of potential benefits and costs," and that project evaluations "should accurately reflect all primary direct and indirect benefits as well as secondary benefits." We share this concern. It is our *special* concern, however, that current deliberations to broaden the concept of project benefits not take place in isolation from some basic principles pertaining to appropriate economic concepts of social benefits and social costs.

In both the private sector and the public sector, decision-makers who strive to develop good policy for their organizations evaluate uses of funds to insure that the expected returns exceed the costs. While the basic notion of benefit and cost evaluation is similar for both the private and public sectors, there is one basic difference. When decision-makers in the private sector, say in a private business,

evaluate the benefits of investing in a new production facility and compare those benefits with associated costs, they are concerned only with the gains and losses which accrue to their firm. Because any other gains and losses which may accrue to outside parties do not show up in the revenues and costs of their firm, they are typically ignored in private investment evaluation. On the other hand, a responsible decision-maker in the public sector cannot adopt so restricted a view. He must conceive of his investment project in a more comprehensive way so that all of the costs and gains associated with the undertaking are accounted for in the investment decision whether or not all appear as receipts of, or disbursements by, his particular agency. Indeed, it is just because market-governed private organizations cannot charge for third-party benefits, or be held liable for third-party costs that the public sector must undertake so many resource development activities.

But even when some agency of the public sector undertakes a resource development or management project, it is not clear that all impacts on third parties will be accounted for. First it is necessary that the "project" be defined so that all physical impacts are included in the scope of the "project." For example, a hydro power project must be defined to include all downstream effects of the dam's storage and release cycle, as well as effects on the quality of water in the reservoir and downstream from the project. An irrigation project must be defined to include the downstream effects of quantity and quality diminution as well as all drainage facilities which will be needed to keep the project in operation—even if they will not be needed for some period following initial project construction.

The second difficulty which can stand in the way of a complete evaluation of a project's impacts even when undertaken by a public body is a jurisdictional one, namely the "accounting stance" or geographical scope of concern assumed by the decision-making body. The "accounting stance" may or may not incorporate all of the effects of the project (properly defined). As an example, downstream impacts of waste treatment may lie entirely outside the jurisdiction of the city responsible for the treatment plant. If a project induces significant changes in market prices, regions quite remote from and possibly even non-contiguous with the project site may incur significant benefits or costs, especially if there are problems of chronic unemployment or immobility of human and capital resources. If, for example, a proposed Bureau of Reclamation irrigation project located in Nevada is evaluated from the state's point of view, it is likely to have an enormous benefit-cost ratio. Clearly, most of the benefits from the project in the form of increased farm incomes will accrue to residents of Nevada. Because of existing repayment (pricing) policies for federal irrigation projects, much of the costs are federal

government costs and only a small proportion of them will fall on people living in Nevada. If the increased agricultural production in Nevada lowers farm product prices and displaces agricultural output in other regions with subsequent temporary or long term income losses (a real national cost), the vast majority of the losers are likely to be in other parts of the country. Thus, if evaluation were made from a broader perspective, the benefit-cost ratio obviously would be reduced. Evaluated from this broader view, the project might or might not be in the national interest. When the project is evaluated from the national point of view, gains to all the beneficiaries and losses sustained by all the cost-bearers will be included in the calculation. It is, therefore, not necessarily true that what is good for Region X is good for the United States.

One elemental principle for benefit-cost measurement of *federal* natural resource development expenditures derives immediately from this discussion of accounting stance. By definition, federal natural resources development is sponsored and financed by the national government, which represents all of the people of the United States. For this reason, we conclude that:

> I. *Federally-financed investments require a national accounting stance in evaluating social benefits and social costs.*

While citing this as a basic principle, we are not arguing that analyses of the benefits and costs accruing to more localized regions should not be estimated. We are arguing, however, that federal natural resource agencies have a *primary* obligation to weigh the costs and benefits of projects from a national point of view and a significantly smaller responsibility to weigh the impacts of projects on regional economies where such local impacts are in fact offset elsewhere in the economy.

While this definition of an appropriate federal accounting stance is a primary principle in establishing a correct benefit-cost criterion, it does not provide many clues to the accurate measurement of these national benefits and costs. To address this measurement problem, we require some notion of the basic underlying characteristics of the economy.

In large measure, the U.S. economy relies on the freely-arrived-at decisions of consumers and producers in getting private goods and services produced. Under these market arrangements, the economy has repeatedly shown a fluid response to changed conditions and has demonstrated an enormous potential for growth. Changing demands elicit a changed pattern of supply with little time lag, without the need for some central authority first to recognize the existence of the new demands, and then convey them to the produc-

tion managers in the form of new production orders. Similarly, changes in technology or in resource availability are usually quickly recorded by the market through altered relative prices.

This mechanism of conveying information about changes in tastes, technologies, and resource availabilities throughout the rest of the economy is a simple one. If parties with altered demands place additional orders for a commodity, producers will be faced with decreasing inventories or a backlog of unfilled orders. Viewing these as opportunities for increasing sales and profits, producers will increase their output. If, in the process of generating these increased outputs, profits rise, an added inducement to producers to increase production will be provided. Resources are thus diverted from producing other things to the production of the commodity with an increased demand. This response is accomplished without central guidance.

Such output responses occur fairly quickly and will usually yield outputs conforming to the patterns of demand at minimum cost. Naturally, the facility with which such responses are made is dependent upon quick communication of market information and the push of effective competition.

It is on the basis of this reasoning that we conclude that an economy which has well-functioning markets as the mechanism to allocate resources produces maximum national output (and income) for the society.

The economic efficiency characteristic of a smoothly functioning market economy has implications for public investment policy in the natural resource area. It suggests that the outputs of public investments should be evaluated by the actual or simulated market demands of users in terms of their willingness to pay, that is, to forego other products, and that the costs must measure the value of the opportunities foregone by diverting inputs to the public investment from other uses. Were public sector investments to be chosen on other grounds, they would be employing resources which could be producing a greater value in other uses. Such public undertakings, by diverting resources from a higher to a lower valued use, would cause a decrease in society's economic well-being. Indeed, if it is assumed that the market system is operating smoothly, it follows that the federal government should not consider a proposed project as adding to the nation's economic well-being unless the observed or simulated willingness to pay for the output exceeds the social value of the resources required to produce the output. These concepts of benefits and costs correspond to what are commonly known as primary benefits and primary costs. We therefore conclude as a second basic principle that:

II. *Unless there are serious market failures and obstacles to the smooth functioning of the market system, total national economic benefits equal the real outputs of a public project valued at observed or simulated market prices and total national economic costs equal the real inputs employed in a project valued at observed or simulated market prices.*

Having set forth a definition of relevant economic benefits and costs for a market economy without serious imperfections, we would do well to state the conditions which must prevail if Proposition II above is to be logically valid. The conditions which must be met in the economy are:

1. Reasonably full employment of labor and capital;
2. Labor and capital mobility, i.e., the ability of units of labor and capital to shift to new jobs and uses;
3. No significant economies from large-scale production of pertinent commodities; and
4. Generally competitive conditions.

If these conditions are met to a reasonable approximation, then any *secondary* beneficial impacts by a project on market-related activities are simply local or regional in nature with *offsetting effects* occurring elsewhere in the economy. If funds are diverted from the private sector for purposes of public investment, not only are primary impacts of the foreclosed private investment foregone, but so are any net secondary impacts. If we wish to credit public investments with their own secondary benefits, we must also take into account the net secondary impacts which would have been experienced through the foregone private spending. There is no more reason to anticipate positive *net* national gains from secondary impacts than to expect negative net changes.

Suppose, for example, that a federal irrigation scheme producing water for various crops is constructed. Certain regional industries will expand, both to supply fertilizer and machinery to the irrigation scheme, and to process and merchandise the crops. If the economy exhibits efficient operation characterized by the above-stated conditions, competition and mobility will provide additional labor and capital to these industries which will eliminate whatever temporarily higher profit rates they experience from the expansion. After the influx of labor and capital stimulated by the temporarily higher profit rates, profitability will fall to a normal rate in short order, and before long, this capital will be earning approximately what it had earned elsewhere prior to the project.

The people newly employed in these activities were bid away from other jobs, implying the existence of higher wages and incomes,

but again, competition among mobile workers will tend to reduce and ultimately eliminate wage differentials. Therefore, in the absence of significant departures from the four above conditions, secondary gains, if significant at all, will be temporary.

In the context of a national accounting stance and assuming that the economy can be characterized as a smoothly functioning market economy, relevant national secondary impacts will be negligible on both the benefit and cost side. This leads us to a third principle:

> III. *If the conditions for a smoothly functioning market economy prevail, there is no justification from a national point of view for the recording of secondary benefits which would accrue to the region of project location, nor for the recording of secondary costs which are experienced elsewhere in the economy due to the financing of the public project.*

The logic of the two preceding principles also generates the conclusion that where serious market imperfections are present, there may be secondary effects which do entail changes in the nation's net income and which will require either the measurement of secondary benefits and costs or adjustments to the observed values of primary benefits and costs. For example, when serious and intractable regional unemployment exists or when the nation as a whole is confronted with unemployed resources, or where a region with immobile labor and capital is confronted by a loss of some vital resource base, then a natural resources development project may result in secondary local income gains which are also net national gains. Adjustments to observed market prices of project inputs and outputs may also be required.

As an example of how secondary effects which accrue to a region may represent changes in national income, consider the case of immobile labor and capital. If labor and capital cannot (or do not) move quickly out of industries which are forced to contract as a result of the construction of a natural resources project (e.g. the displacement of non-irrigation agriculture by irrigated acreage), they will experience a decrease in their net incomes. This decrease in net incomes represents a reduction in national output over the period of the unemployment of these resources. Because a loss in the nation's income is experienced as a result of this immobility, federal planners should legitimately account for the loss in estimating project costs.

A second example of how secondary effects may lead to national increases in income relates to the existence of increasing efficiencies of large-scale production in some pertinent production sectors.

Assume that because of a natural resources development project, certain industries expand while others contract. If the expanding industries experience decreasing unit costs while the industries experiencing contraction have constant product costs, and if the degrees of expansion and contraction are approximately equal, then a similar volume of output will be produced at a smaller total input cost. The reduction in input cost constitutes a net national benefit and, like the above examples, represents a case in which real *secondary* economic gains occur for the nation.

An example of how an imperfectly working economy may require an adjustment of observed market values of project inputs and outputs can be cited in terms of the impact of, say, a dam building project whose construction period coincides with substantial unemployment of labor. If the on-site labor used would otherwise have been unemployed, its true social cost will lie below the apparent market cost. If off-site procurement requires production which utilizes otherwise unemployed labor, even in far-away regions, the cost of those off-site procurements must be reduced. Appropriate techniques for these adjustments have been developed.

From these examples, a further basic principle of benefit-cost measurement is derived. This principle, which is a corollary of the previous principle, can be stated as follows:

> IV. *When the economy is characterized by unemployment, resource immobility, decreasing costs, or a lack of competition, it is appropriate to investigate net national benefits and costs which derive from secondary effects. Such benefits, when found and quantified, should enter the benefit-cost analysis.*

Having offered this principle, however, we would also emphasize a few *caveats* which relate to it. First, it should be pointed out that the unemployment relevant to the existence of real national secondary benefits generated by project construction must be long-term, structural unemployment, and not just that from a temporary recession. The planning-construction period and the operating life of natural resources projects each will exceed the duration of cyclical unemployment.

Second, we would also emphasize that labor and capital immobility should not be presumed to be a permanent feature of the social landscape. It is often on the basis of such immobility that "rescue operations" are proposed to bring water to established agricultural areas to replace exhausted ground water supplies. Because business complexes which specialize in agriculturally related activities as well as agriculture itself would be left idle if the area were forced to revert to dry farming or to abandon farming altogether, the

existence of substantial net secondary benefits for such investment has often been claimed. Surely over the period when capital and labor would otherwise have remained idle, the newly generated capital and labor income should be counted as a net national gain, as should any difference in land rent. It must be pointed out, however, that units of capital and labor will be immobile for a far shorter period than the life of the project. For this reason the incomes from avoided unemployment should be attributed as benefits to the water supply project only over the appropriate periods of immobility. The fact that technological and market changes would be inducing changes in employment and capital structure independent of matters of water supply makes it doubly difficult to apply the "with-without" criterion.

A third caveat pertains to longer term growth which might be induced by the project and the relationship of this growth to national gains. Clearly, the question of the contribution which such growth makes to national economic gain hinges on the possible advantages which exist for, say, processing primary products in that region relative to other areas. It is not warranted to assume that any particular project will automatically generate such related investments or that the incomes generated by such investments represent net additions to the national income. What is needed is a careful analysis of the extent to which the project creates in the region a comparative advantage relative to other regions in terms of basic raw materials, power, process water, or transportation. Moreover, if it is concluded that project-induced investment is likely to occur in the project area, the portion of the incomes created by this new activity representing net additions to the national income and the portion representing transfers from other areas must be determined. Only the net additions are countable as benefits.

Any such analysis of project-induced investment should be approached with care in the case of presently depressed areas, since it is reasonable to presume that the conditions which have resulted in a declining area's depressed economic condition will continue to inhibit further investment. It is unlikely, for example, that the provision of flood-free land or an improved water supply will suffice to make private investments profitable.

Finally, if the federal government is interested in inducing development in a particular region or set of regions, it should not be restricted in its choice of instruments to water resource or, more generally, natural resource development investments. Indeed, there is no presumption whatsoever that natural resource investments are more likely to be significant employment or investment generators than labor training programs, housing programs, recreation programs funded by the federal government, or federally subsidized private investments in the region, or federal investment in programs to

relocate population groups presently immobilized in low potential regions. In appraising any particular natural resource investment as an instrument for regional development, the analyst should be fully aware of the other alternative policy measures, and should recognize that, while some development impacts derive from the project, the same or even greater effects may be attributable to other types of public (or publicly-encouraged private) investments.

While there exist, then, conditions under which secondary benefits can legitimately be included in benefit-cost calculations, or under which project costs may have to be adjusted to reflect deviations from social cost, it must be realized that the knife which cuts on the benefit side also cuts on the cost side. When the necessary conditions for the existence of secondary benefits hold, it is equally likely that project financing or project output will induce secondary costs. Consider the impact of the reclamation of arid lands on the remainder of agriculture. It has been demonstrated that the reclamation program in the western states by encouraging increased western cotton production has displaced a significant portion of the cotton production previously grown in southern states. Indeed, it has been estimated that the result of the western program has been to displace one out of every twenty farmers remaining in southern agriculture*. The displaced southern farm family not only remains unemployed for some period (a national income loss), but, like other displaced laborers, migrates to the city. If providing opportunities in the West to permit rural families to remain in the countryside or to permit urban families to leave the cities is to be attributed as a (non-quantifiable) benefit, then providing the inducement for rural families in other regions to migrate to the cities must be tallied as a cost.

The point of this example, then, is a clear one. Namely:

> V. *If market imperfections cause projects to generate secondary benefits which coincide with national income gains, they also generate secondary costs. The existence of market imperfections requires that both secondary benefits and costs be accounted for in benefit-cost calculations.*

The importance of this principle, then, is that it points up the need for the development of information on both the secondary benefits and the secondary costs of natural resource development projects if market imperfections are present.

Next, it must be noted with emphasis that natural resource development projects have some real impacts, both beneficial and

*George S. Tolley, "Reclamation's Influence on the Rest of Agriculture," *Land Economics*, May 1959, pp. 176-80.

detrimental, which are of social concern and which are not in practice included in the measurable primary and secondary benefits and costs discussed above nor even described in the typical project report. The most important of these impacts might be:

1. types of benefits or costs which, while conceptually belonging in the national income accounts, are not at present quantified. Examples might be the benefits from water quality improvement beyond those associated with changed municipal and industrial water costs, the values from preserving a scenic stretch of natural river, or the preservation or destruction of fish and wildlife.
2. regional income impacts which, while not reflecting net national gains, reflect the regional distribution of project benefits and costs. If the gains and losses to all regions were fully accounted for, their sum would equal the project's net national benefits. Such information should clearly be of interest to decision-makers concerned with regional progress and matters of equity among regions.
3. impacts on the inter-personal distribution of income and other effects on human well-being such as the saving of life and the reduction of risk and uncertainty.

Non-marketed outputs of the first type have economic values to society no less than do irrigated crops or transportation cost savings. Attempts should continue to develop methods for simulating values for such outputs in the absence of markets. When such values cannot reasonably be computed, full descriptions of these impacts should be included in the project report. The same can be said for the other classes of beneficial and detrimental impacts.

Because quantifiable economic benefits still predominate among the outputs of natural resource developments, it is argued here that primary emphasis in the design and selection of natural resource projects should still be placed upon the national income impacts. At the very minimum, if projects whose national income costs exceed their national income benefits are to be undertaken in order to serve these other social goals, the corresponding *national income benefits and costs should still be carefully assessed.* No attempt should be made to allocate any part of the national income costs of the project to the attainment of other social goals, for such a partitioning of costs would leave the national income benefit-cost comparison meaningless. It might be helpful to note in the project report approximately what portion of the project cost was attributable to "overdesign" as a means of achieving other goals, but provision of such information must not be permitted to obscure the comparison of *total* national income benefits and costs.

On the basis of these considerations we conclude that:

VI. *The basic economic rationale justifying public sector responsibility for natural resource development requires that the criterion of national income enhancement serve as the primary criterion for choice among investment alternatives, and that the extent to which natural resource investments contribute to the attainment of other social objectives be expressed in side displays of information and analyses. There should be no allocation of national income costs to the attainment of other objectives.*

Within the framework of these basic economic principles, there exists a great deal of room for improvement in the procedures and methods for evaluating benefits and costs. By way of conclusion, we would offer two suggestions consistent with the above principles on which future efforts for improving benefit and cost measurements should be concentrated.

First, it was noted above that there is a need to account more fully for the direct or primary consequences of natural resource investment projects. Mentioned, for example, were scenic amenities, recreational opportunities, and the preservation of fish, wildlife, and free-flowing streams, all "outputs" which have value, even though they are not priced in the market. Surely the fuller evaluation of these direct, identifiable outputs represents a better application of the limited research resources available to agency planning staffs than probing for much less obvious and difficult-to-measure secondary effects.

Reasonably good methods are continually being developed for the evaluation of these important but difficult-to-quantify primary benefits. Examples are the methods now available to estimate recreation benefits and procedures for the measurement of flood damage reduction in the case of flood control installations. We would urge renewed efforts to develop and gain consensus on appropriate methodologies for the estimation of values for these nonmarketed outputs. In our judgment, this is the first order of business.

Second, it is recommended that policies covering the pricing of outputs of national resource projects and other aspects of cost-sharing by benefited parties and regions be reconsidered. The objective should be greater efficiency in the design and use of resource projects and their outputs by imposing appropriate costs on the users. Since all costs must be borne by someone, such a policy will probably be not only more efficient than current policies but substantially more equitable.